

WHAT IS CLAIMED IS:

1. A flow control device comprising:

an opening part through which an upstream side of a fluid flow passage is in communication with a downstream side of the fluid flow passage;

a valve element for closing the opening part, the valve element comprising:

a large flow rate controlling valve element capable of adjusting an opening degree of the opening part;

a sealing member provided with a valve hole having an open area smaller than the opening part and formed to be capable of being brought into tight contact with a peripheral wall part of the opening part; and

a small flow rate controlling valve element capable of adjusting an opening degree of the valve hole; and

a valve drive device which rotates to drive the valve element in a closed direction for closing the opening part or in an opened direction for opening the opening part.

2. The flow control device according to claim 1, wherein the sealing member comprises:

a closed state in which the sealing member is in tight contact with the peripheral wall part of the opening part to close the opening part and the valve hole of the sealing member is substantially closed by the small flow rate controlling valve element;

a small flow rate state in which an opening degree of the valve hole of the sealing member is adjusted by the small flow rate controlling valve element while the sealing member is in tight contact with the peripheral wall part of the opening part; and

a large flow rate state in which the sealing member is moved apart from the peripheral wall part of the opening part by the large flow rate controlling valve element such that the opening degree of the opening part is adjusted by the large flow rate controlling valve element.

3. The flow control device according to claim 2, further comprising a motor as a driving source and a transmission mechanism which transmits an output of the motor to the valve element for moving the valve element in the opened direction or the closed direction.

4. The flow control device according to claim 1, wherein the small flow rate controlling valve element is a rod-shaped valve element formed so as to extend in a driving direction of the valve element and fit within the valve hole so as to be movable within the valve hole, a front end portion of the rod-shaped valve element is fixed to the large flow rate controlling valve element with a diameter larger than that of the valve hole of the sealing member, movable along with the large flow rate controlling valve element in an integral manner, and capable of adjusting a clearance area to an inner face of the valve hole of the sealing member according to a penetrating depth of the rod-shaped valve element into the valve hole of the sealing member, and the

sealing member moves apart from the opening part in a large flow rate state.

5. The flow control device according to claim 4, wherein the rod-shaped valve element is formed in such a manner that a mid portion of the rod-shaped valve element has an outer diameter capable of substantially closing the valve hole of the sealing member and a front end side part from the mid portion is formed thinner such that a diameter is slightly decreased towards an end portion of the front end side part of the rod-shaped valve element.

6. The flow control device according to claim 4, further comprising a spring member disposed around the rod-shaped valve element for energizing the sealing member towards the peripheral wall part of the opening part.

7. The flow control device according to claim 4, further comprising a groove-shaped flow passage formed between the sealing member and the large flow rate controlling valve element in a state that the large flow rate controlling valve element abuts the sealing member,

wherein a flow rate in the groove-shaped flow passage is roughly equal to a flow rate when the opening degree of the opening part is minimized by the large flow rate controlling valve element.

8. The flow control device according to claim 1, further comprising a front end portion of the large flow rate controlling valve element formed narrowly tapered such

that a diameter of the front end portion of the large flow rate controlling valve element decreases towards a front end side,

wherein the tapered front end portion of the large flow rate controlling valve element enters into an inner side of the opening part and is capable of adjusting the opening degree of the opening part.

9. The flow control device according to claim 1, wherein the valve element is driven by the valve drive device so as to follow an arc-shaped trajectory and the opening part is formed opened in a peripheral direction so as to be inserted by the large flow rate controlling valve element.

10. The flow control device according to claim 9, wherein both the large flow rate controlling valve element and the small flow rate controlling valve element are formed in a curved shape so as to be along the arc-shaped trajectory of the valve element.

11. A flow control device comprising:

an opening part through which an upstream side of a fluid flow passage is in communication with a downstream side of the fluid flow passage;

a valve element for closing the opening part, the valve element comprising:

a large flow rate controlling valve element capable of adjusting an opening degree of the opening part;

a sealing member provided with a valve hole having an open area smaller

than the opening part and formed to be capable of being brought into tight contact with a peripheral wall part of the opening part; and

a small flow rate controlling valve element capable of adjusting an opening degree of the valve hole; and

means for rotating to drive the valve element in a closed direction for closing the opening part or in an opened direction for opening the opening part.

12. The flow control device according to claim 11, wherein the sealing member comprises:

a closed state in which the sealing member is in tight contact with the peripheral wall part of the opening part to close the opening part and the valve hole of the sealing member is substantially closed by the small flow rate controlling valve element;

a small flow rate state in which an opening degree of the valve hole of the sealing member is adjusted by the small flow rate controlling valve element while the sealing member is in tight contact with the peripheral wall part of the opening part; and

a large flow rate state in which the sealing member is moved apart from the peripheral wall part of the opening part by the large flow rate controlling valve element such that the opening degree of the opening part is adjusted by the large flow rate controlling valve element.

13. The flow control device according to claim 12, further comprising a motor as a driving source and a transmission mechanism which transmits an output of the motor to the valve element for moving the valve element in the opened direction or the closed direction.

14. The flow control device according to claim 11, wherein the small flow rate controlling valve element is a rod-shaped valve element formed so as to extend in a driving direction of the valve element and fit within the valve hole so as to be movable within the valve hole, a front end portion of the rod-shaped valve element is fixed to the large flow rate controlling valve element with a diameter larger than that of the valve hole of the sealing member, movable along with the large flow rate controlling valve element in an integral manner, and capable of adjusting a clearance area to an inner face of the valve hole of the sealing member according to a penetrating depth of the rod-shaped valve element into the valve hole of the sealing member, and the sealing member moves apart from the opening part in a large flow rate state.

15. The flow control device according to claim 14, wherein the rod-shaped valve element is formed in such a manner that a mid portion of the rod-shaped valve element has an outer diameter capable of substantially closing the valve hole of the sealing member and a front end side part from the mid portion is formed thinner such that a diameter is slightly decreased towards an end portion of the front end side part of the rod-shaped valve element.

16. The flow control device according to claim 14, further comprising a spring member disposed around the rod-shaped valve element for energizing the sealing member towards the peripheral wall part of the opening part.

17. The flow control device according to claim 14, further comprising a groove-shaped flow passage formed between the sealing member and the large flow rate controlling valve element in a state that the large flow rate controlling valve element abuts the sealing member,

wherein a flow rate in the groove-shaped flow passage is roughly equal to a flow rate when the opening degree of the opening part is minimized by the large flow rate controlling valve element.

18. The flow control device according to claim 11, further comprising a front end portion of the large flow rate controlling valve element formed narrowly tapered such that a diameter of the front end portion of the large flow rate controlling valve element decreases towards a front end side,

wherein the tapered front end portion of the large flow rate controlling valve element enters into an inner side of the opening part and is capable of adjusting the opening degree of the opening part.

19. The flow control device according to claim 11, wherein the valve element is driven by means for rotating to drive so as to follow an arc-shaped trajectory and the opening part is formed opened in a peripheral direction so as to be inserted by the

large flow rate controlling valve element.